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Vol. III 1914 No. 7

A Review of Some Philippine Plant Diseases

C. F. Baker

Professor of Agronomy, College of Agriculture, University of the Philippine.

Cultivated, as well as wild plants, in the Philippines, have their fungous diseases just as in other countries, and some of these diseases are extremely serious, causing constant and heavy loss. Scant attention seems to have been paid them and very little has been published on them, although they are fully as worthy of attention as are injurious insects.

Large sums have been devoted to the study and the combating of a number of the more spectacular insect pests in the Islands, while we have never had an expert plant pathologist to cover the field of the more insidious plant diseases, though the annual loss through these agencies is as great, if not greater, than that caused by insects.

Of the plant diseases peculiar to the Islands, almost nothing is known of their modes of infection, the actual losses caused by them, or the preventative, curative, or sanitary measures necessary to their control. The causative factor in infection, and even the identity of the fungus involved is as yet unknown in many cases. Yet to a fungus belongs the chief credit for wiping out the coffee industry in the Philippines. Some idea of the newness of the field may be gathered from the fact that in a very superficial and local survey of plant diseases occurring near Los Baños during the past two years, a large proportion have turned out to be caused by species of fungi that are wholly new to science. Others widely distributed through the Islands, and everywhere causing loss, have not, up to this time, even been reported from the Philippines in print. The following review represents only such material as has already been reported on by the expert mycologists Dr. H. Rehm of Munich, Mr. H. Sydow of Berlin, and Dr. P. Saccardo, of Padua who have been studying our material. Many other fungi of importance equal to some of those mentioned are as yet unde-

termined and will be reported on later. Full bibliographic and host references will be found in a complete bibliographic and synonymic list of all the known Lower Fungi of the Philippine Islands, which I have published as Art. 102 in Vol. VI of Mr. Elmer's "Leaflets of Philippine Botany" and in an extensive supplement to that list which is now in course of publication.

A large part of our results at the College have been due to the remarkable aptitude and interest of two of our student assistants, Mr. M. B. Raymundo and S. A. Reyes.

ALOCASIA MACRORHIZA—Bigá.

This plant, as well as *A. indica*, is affected by a leaf spot due to *Mycosphaerella alocasiae* Sydow. These plants, as also our cultivated *Colocasia* (Gabi), are commonly affected by a serious anthracnose which may be due to a *Glocosporium* the same as, or near to *G. graffii* Sydow, found on *Aglaonema densinervium*.

ANDROPOGON CITRATUS—Lemon Grass.

This has been reported as affected by a rust, *Puccinia citrata* Sydow.

ARACHIS HYPOGAEA—Peanut or Mani

Scarcely a field of peanuts but can show many leaves affected by a roundish, ultimately black leaf spot, the plants sometimes being covered to the extent of killing most of the leaves. This characteristic disease is due to *Cercospora personata* (B. et C.) Ellis. It is probably the same as a Javan disease of peanuts referred to the work of *Septogloeum arachidis* Racib, and would be better referred to the genus *Septogloeum*.

ARECA CATECHU—Betel Palm or Bunga.

The leaves of this palm at Los Baños have been found to be attacked, often extensively, by a new fungus, *Gloeosporium catechu* Sydow. In Palawan, Mr. Merrill has found a remarkable series of new fungi on the Betel Palm, mostly on petioles and sheaths and part of which are saprophytic. These include *Colletotrichum arecae* Sydow, *Phomopsis arecae* Sydow, *Peroneutypella arecae* Sydow and *Phellostroma hypoxyloides* Sydow.

ARENGA SACCHARIFERA—Cabo negro.

This common and most useful palm is a very remarkable fungus host. Leaves, spathes and petioles all carry an extensive fungus flora. Only a few of these fungi, however, seem to be primary causes of death of tissue, the majority being saprophytes living on tissues dead or dying from other causes. We already have some dozen or more determined, largely new to science, and many more still unstudied. One of the most interesting fungi found on Arenga is the new *Gilletiela latemaculans* Rehm, occurring on the leaves.

ARTOCARPUS INCISA—Jack Fruit.

The living leaves of this common tree are attacked by the new *Cercospora artocarpi* Sydow, and when languishing, by *Diplodia artocarpi* Sacc., also new.

ARTOCARPUS INTEGRIFOLIA—Nangka.

On the leaves of this very common bread fruit, Raimundo has found two new fungi, *Diplodia artocarpina* Sacc., and *Dichotomella areolata* Sacc., the latter representing a new genus. The male inflorescences are commonly destroyed by the Javan *Rhizopus artocarpi* Rac., a most interesting fungus.

BAMBUSA BLUMEANA—Cauayan.

Locally at any rate, this species with spiny branches at base, is our most important structural bamboo. So far as known to date it is by far the most prolific fungus host in the Islands, being attacked, both living and dead, by a great number of fungi belonging

to many groups. The living leaves are attacked and destroyed in enormous quantities by such fungi as *Ophionectria erinacea* Rehm, *Trichosphaeria bambusicola* Rehm, and *Phyllachora orbicula* Rehm, all new to science. On the leaves are also found *Homostegia fusispora* Syd., *Scirrhia luzonensis* Henn. and *Scirrhia bambusina* Penz. et Sacc. The huge stump masses form ideal situations for many Basidiomycetes, some of which are doubtless at least partly instrumental in killing matured stems. A black rot, perhaps bacterial in nature, has been observed attacking the young soft sprouts. Of the many fungi attacking dead stems the only ones of pronounced economic importance are two species of *Physalospora*, *P. bambusae* (Rabh.) Sacc., and *P. bambusicola* Rehm, both of which attack the bamboo even after it is worked into permanent structures of various kinds. Attack could doubtless be entirely prevented by painting, or dipping in certain preservatives. Also in structures that are so located as to be continually moist there is often extensive attack by the common *Eutypa bambusina* Penz. et. Sacc. originally described from Java, which is easily recognized by the large linear, and crowded black sori. We already have more than thirty species of named fungi taken on this bamboo, and many others still undetermined.

Brassica spp.

The various salad plants known as Pe-tsai, Napa, and Mostaza, important vegetables in the Philippines, are frequently seriously affected by a leaf spot caused by *Cercospora armoraciae* Sacc. More open planting, and prompt clearing away and destroying of affected lower leaves will probably reduce the injury to a minimum. In one observed case of attack, more than half the leaves were ruined for marketing.

Calamus spp. and Daemonorops spp.

The rattans of the forest are very susceptible fungus hosts, many, both saprophytic and parasitic, having already been reported. Both leaves and stems appear to form an inviting place for fungi. These fungi need to be more thoroughly studied everywhere in the Islands.

Canavalia ensiformis and C. gladiata—Sword Beans, Horse Beans.

The white as well as the red seeded horse bean is attacked by numbers of seriously active parasites. One of these—the very interesting *Elsinoe canavaliae* Rac.—causes wide spread distortion and death of both leaves and stems. *Gloeosporium canavaliae* Syd. and *Cercospora canavaliae* Syd., two new fungi, are also common.

Capsicum frutescens—Red Pepper.

Mr. Sydow recently sent me a specimen of his new *Vermicularia capsici*, described as occurring on pepper-pods in India. I immediately asked Reyes to look for it among our peppers. In a short time he brought to me the identical fungus, and we now find it common here.

Carica papaya—Papaya.

This most important economic plant is everywhere attacked by fungi. The stems are killed in large ever spreading areas, the leaves are commonly fungus spotted and the fruits are rapidly attacked by various fungi as soon as ripe. *Aspergillus periconioides* Sacc. has been found on failing leaves at Lamao. On dead and dying petioles we have taken *Colletotrichum papayae* (Henn.) Syd., and *Diplodia caricae* Sacc., the latter new. Leaves are commonly attacked by the new *Mycosphaerella caricae* Syd.

Carthamus tinctorius—Asafran.

The foliage of this plant is frequently entirely destroyed and the plant killed, by a leaf disease, due to the new *Cercosporina carthami* Syd.

CLITORIA TERNATEA—Conchita or Pokingan.

This common ornamental vine is commonly sadly disfigured during the dry season by a leaf spot caused by *Cercospora pantoleuca* Sydow, a species new to science.

CITRUS NOBILIS—Tangerine, Narangita.

This is one of our most commonly planted citrus fruits. The trees are commonly not cared for, practically never pruned or sprayed and they are usually thoroughly fungus ridden. Mr. Graff found the new *Cytospora aberrans* Sacc. on twigs. Raimundo went out one day and within a half hour had found a considerable number of important parasitic and saprophytic fungi on twigs and branches of tangerine. These included *Eutypella citricola* Speg., *Valsaria citri* Rehm, *Massarina raimundoi* Rehm, and *Diaporthe citrincola* Rehm, the three last being new to science. *Phyllosticta circumsepta* Sacc., may be frequently found on the fruit itself.

COCOS NUCIFERA—Coconut.

A very common coconut leaf parasite, often causing extensive death of tissues in the leaves, is *Pestalozzia palmarum* Cke. et Grev. Other leaf parasites taken by us have not yet been determined. Cases of apparent rot seem to start, sometimes at any rate, with the work of the coconut beetles. Numerous basidiomycetes grow about the bases of coconut trunks, and even among the sheathing leaf bases, and the relation of all these to the life of the tree is as yet unknown. The leaves also bear *Capnodium footii* Berk. et Desm. which blackens them, but is apparently confined to feeding on honey dew from coccids. On the husks may be found *Eutypella cocos* Ferd. et Winge and *Diplodia cococarpa* Sacc. Mr. Merrill has recently found two interesting new fungi on coconut in Palawan, *Anthostomella cocoina* Syd. on dead petioles and rachises, and *Palawania cocoes* Syd. on dead spathes.

COFFEA ARABICA—Coffee.

Down to this date, only two fungi have been reported from coffee in the Philippines, *Coniothyrium coffeae* Henn., and *Hemileia vastatrix* B. et Br. The latter is the devastating and much dreaded coffee rust that has so long been the bane of coffee growers in the Orient. It seems however, from recent experiments, that it can be controlled by the spraying of Bordeaux mixture. If tropical agriculturists were one half as well versed in the use of copper salts and various preventative practices, as are agriculturists of temperate regions, vast losses from these causes could be largely prevented. In the orange orchards of Southern California, hundreds of thousands of dollars are spent annually in fumigation and spraying, and with most remunerative results. The same can be said of many purely temperate region crops. In the tropics it is exceedingly rare to find a planter who either owns a spray pump or knows how to make up spraying mixtures.

In connection with the study of coffee rust in the Philippines careful account should be taken of various forms of *Hemileia* occurring on wild rubiaceous plants, such as *Hemileia canthii* B. et Br., which occurs on *Plectronia*.

CORYPHA ELATA—Buri Palm.

This large fan-leaf palm is also a very susceptible fungus host, both the living and dead portions bearing many species, including *Septoria palmarum* Sacc., which we have not yet noticed on other palms although it doubtless occurs on them. Both *Gloeosporium* and *Pestalozzia* attack the leaves, though their specific identity is not yet made out.

CROTON TIGLIUM—Croton-oil Plant.

Two fungi have been reported from this plant in the Philippines, *Placosphaeria tiglii* Henn., and *Cercospora tiglii* Henn.

CYAMOPSIS PSORALEOIDES—Guar.

This new and promising legume, only recently planted here, is sometimes well covered with a newly described fungus, *Macrophoma cyamopsidis* Syd.

DIOSCOREA spp—Ubi, Yams.

Our Dioscoreas are affected by a number of fungi, of which four so far determined are leaf parasites. A rust, *Uredo dioscoreae-alatae* Racib., and a leaf spot, *Cercospora ubi* Racib., both originally described from Java, may be injuriously abundant, while a new local fungus, *Cercospora pachyderma* Syd., may also be common. Another leaf parasite of lesser importance, appearing as a small black spot, is *Phyllachora dioscoreae* Schwein. A black rot of the tubers, which may be bacterial, has been observed. *Phoma Oleracea* Sacc. is common on the dead stems.

DOLICHOS UNIFLORUS—Horse Gram.

This legume is a promising crop for the dry season, but in the wet season, though its growth is rank, it is fairly swamped with fungi—particularly with one of the wilt diseases and a sclerotial disease. We have also recently found two new fungi on it, *Didymella lussoniensis* Sacc. and *Vermicularia horridula* Sacc.

DURIO ZIBETHINUS—Durian.

Only two fungi are reported from durian, one, *Placosphaeria durionis* Sydow, being a leaf parasite, and the other, *Diplodia durionis* Sacc. et Sydow, recently new to science, attacking the seed coats of cleaned seed.

EUPHORBIA NERIIFOLIA—Soro-soro.

This large fleshy stemmed cactus-like Euphorbia is a common ornamental plant. On the college grounds its leaves are constantly affected and largely killed by a blackish leaf spot produced by *Colletotrichum euchroum* Sydow, described as new from this place.

FICUS CARICA—Fig.

Adriatic figs planted here grew well at first but were eventually killed despite all our efforts, by a boring beetle-larva of most astonishing activity (*Diochares ambigenus* Chevr.) and by the common fig rust, *Kuehneola fici* (Cast.) Butl. which finally killed the leaves about as fast as they appeared.

GLYCINE HISPIDA—Soy Bean, Soja.

We have in process of acclimatization very promising varieties of soy for both the wet and dry seasons. Some of these varieties are unfortunately very susceptible to a serious rust, *Uromyces sojae* Syd.

GOSSYPIUM spp—Cotton.

Both *G. herbaceum* and *G. braziliense* on the college farm have been continously and very seriously affected with the cotton leaf rust, *Kuehneola demissum* (B. et Br.) The two varieties we happen to have, appear to be extremely susceptible. Should cotton ever be planted commercially in the Islands, other less susceptible varieties should be sought and used.

HIBISCUS ESCULENTUS.

This plant is commonly and seriously affected by an undetermined leaf blight. Raimundo has also found on it the widespread *Gibberella saubinetii* (Mont.) Sacc.

HIBISCUS SABDARIFFA—Roselle.

This valuable garden plant appears to be remarkably free from fungi in our cultures. Mr. Graff has found the new *Phoma sabdariffae* Sacc. on dead twigs.

JUSTICIA GENDARUSSA.

This common ornamental shrubby plant is often disfigured by the large brown patches of a leaf rust, *Puccinia thwaitesii* Berk.

LAGERSTROEMIA INDICA and L. SPECIOSA.

These very ornamental small trees harbor several fungi, only two of which have been determined, viz: *Mollisia ravida* Sydow, and *Rhytisma lagerstroemiae* Rabh. Another, attacking the leaves, has not yet been determined.

LAWSONIA INERMIS.

This ornamental shrub has furnished only one fungus so far, *Asterina lawsoniae* Henn. et Nym., and this is of minor importance.

MANGIFERA INDICA—Mango.

The mangoes are commonly badly afflicted with leaf diseases, and also with an anthracnose on the fruits. Of the leaf diseases, *Meliola mangiferae* Earle is a black superficial fungous of little consequence. A small round leaf spot caused by *Cercospora mangiferae Koord*, is sometimes very injuriously abundant. A large irregular angular spot which may finally involve the whole leaf surface and thus eventually kill it, is caused by *Leptothyrium circumscissum* Sydow, a new species, which is especially injurious to seedlings. *Pestalozzia funerea* Desm. also occurs on the leaves. On the limbs may be found *Endoxyla mangiferae* Henn.

MANIHOT DICHOTOMA—Ceara Rubber.

The foliage of trees of Ceara rubber on the college farm have at times sufferred from the attacks of a new *Phyllosticta, P. manihoticola* Sydow.

MANIHOT UTILISSIMA—Cassava, or Camoting Cahoy.

A leaf spot due to *Cercospora henningsii* Allesch. sometimes causes the loss of all the lower leaves of this valuable economic. On the dying and dead branches Raimundo has found three new fungi, *Diplodia manihoti* Sacc., *Guignardia manihoti* Sacc., and *Colletotrichum lussoniense* Sacc.

MORUS ALBA—Mulberry.

This silk-worm fodder-plant is very subject to fungous attack in both living and dead parts. One of the leaf fungi is a species also common in America, *Phyllactinia suffulta* (Rabent). Sacc. Dead and dying twigs bear some very interesting fungi, one, *Traversoa dothioroelloides* Sacc. et Sydow, representing a new genus and species. Another, *Botryodiplodia anceps* Sacc. et Sydow, and also new, should be studied in connection with the so-called *Lasiodiplodia* of *Theobroma*. Still a third fungus *Valsaria insitiva* (de Not.) Ces. et de Not, may be found on the dead twigs. The leaves are also attacked by the common enemy of many Moraceae—*Kuehneola fici* (Cast.) Btl.

MUSA SAPIENTUM—Banana.

The leaves of bananas are very extensively damaged by actively parasitic fungi, of which we have only one determined, *Mycosphaerella musae* Speg. But others, including a *Gloeosporium*, occur here. Fruits are commonly affected by an anthracnose. Leaves apparently failing from other causes are finally extensively attacked by *Macrophoma musae* (Cke) Berl. et Vogl. About the stumps and on dead leaf sheaths grow a variety of fungi, among them some Basidiomycetes, the relation of which to the living banana is problematical. A heart rot of the stem, possibly of bacterial origin, has been observed. The leaves also support a new *Sporodesmium, S. bakeri* Syd.

NICOTIANA TABACUM—Tobacco.

A whitish spotting of the lower leaves, sometimes extending to the upper leaves as well, and causing extensive and serious damage, is due to *Cercospora nicotianae* Ell. et Ev. It seems to be abundant everywhere. A crowding of the plants together with too much free moisture present, seems to greatly favor the development of the fungus. As a deterrent sanitary measure, the sand-leaves should be harvested as early as possible. The very lowest leaves,

likely to be entirely or partly dead at harvest time, should be cleanly gathered and burned as early as possible. This, with open planting, will reduce the injury to a minimum. By practising this on the college farm, we were able to harvest good percentages of clear leaf, in spite of the leaf spot.

NIPA FRUTICANS—Nipa.

This important palm seems to be a good fungus host, but nothing is known of the life of these fungi in nature. They include *Ophiobolus nipae* Henn., and *Lembosia javanica* (Pat.) Racib.

ORCHIDACEAE.

The orchids should be carefully inspected before exporting and all fungi carefully removed, just as they are likely to be inspected where they are imported. For they are prolific fungus hosts, and some of the fungi are active parasites. *Coleosporium merrillii* Henn., which occurs on various orchids, is a very injurious leaf parasite. *Gloeosporium vanillae* Cke. also injures the leaves. Another orchid fungus which has been named is *Calonectria copelandi* Henn.

ORYZA SATIVA—Rice.

The sclerotial disease of rice, *Ustilaginoidea virens* (Cke.) Takahashi, forming black sclerotial masses in the maturing ovary, is found in these Islands, as well as in most other Far Eastern rice producing countries. At times it causes some loss. Various other rice fungi which we have under observation, have not yet been determined. On failing leaves, Raimundo has found the new *Entyloma oryzae* Syd.

PACHYRHIZUS ANGULATUS—Sincamas.

This garden vegetable, much planted here for its sweet tuberous roots which are eaten raw, is often seriously attacked by a rust, *Phakospora pachyrhizi* Syd.

PAHUDIA ROMBOIDEA—Tindablo.

Phyllachora pahudiae Sydow and the new *Cercospora pahudiae* Sydow commonly affect the leaves of this important timber tree, and are sometimes markedly injurious to the seedlings. The same thing is true of *Phyllachora parkiae* Henn., on *Parkia timoriana* (Cupang), of *Phyllachora afzeliae* Sydow, on *Afzelia bijuga*, and of *Phyllachora pongamiae* (B. & Br.) Petch on *Pongamia glabra*.

Forest Phytopathalogy is a wholly uncultivated field in the Philippines, though we have seen enough to know that it is an exceedingly rich and promising field for scientific investigation.

PASSIFLORA QUADRANGULARIS.

Among a number of fungi living on this plant, only three have been determined for us, *Myiocopron bakerianum* Rehm, *Vermicularia fallax* Sacc. and *Lephodermium passiflorae* Relm, all new to science; the first and third occurring on dead or dying stems, and the second on leaves. Whether they have anything to do primarily with the death of the stems is yet to be determined.

PHASEOLUS CALCARATUS.

Raymundo has found a new *Phyllachora* on this bean,—*phaseolina* Sydow, which is sometimes very injuriously abundant.

PHASEOLUS LUNATUS—Patani.

The pods of the flat beans are commonly attacked by *Cladosporium herbarum* L. and by the new *Diplodia phaseolina* Sacc., even before they are mature and are often covered with them by the time they are ripe. The new leaves are often attacked by the *Cercospora lussoniens* Sacc.

PSIDIUM GUAJAVA.—Guava.

Leaves of guava, of Ixora, of *Sandoricum indicum* (Santol), of *Voacanga globosa*, and some other plants are commonly covered with a dense, black, sooty mould, evidently growing on the honey dew from coccids, aphids, or psyllids. On sight, I had immediately associated this with the common

sooty moulds of orange, guava, and other plants, so common in warmer America. Curiously enough, Sydow makes of this Philippine form a new genus and species, *Aithaloderma clavatisporum*. Another similar fungus on *Mallotus philippinensis*, has been mamed *Limacinula malloti* by Dr. Rehm.

SACCHARUM OFFICINARUM—Sugar Cane.

Only a part of the fungi we have found on cane have been worked up, but three are known as certainly parasitic on living tissues, namely, a rust, *Uredo kuehnii* (Krueg.) Wakk. et Went., a smut, *Ustilago sacchari* Rabh., and a basal purple bordered leaf spot which is probably due to *Cercospora acerosum* Dickh. et Hein. Two species of *Coniosporium*, *C. vinosum* (B. et C.) Sacc. and C. *extremorum* Sydow, occur on failing leaves and are doubtful injurious.

SAPINDUS SAPONARIA—Soap Tree.

Reyes finds that our specimens of this tree frequently have many leaves killed by the new *Mycosphaerella reyesii* Syd.

SESAMUM INDICUM—Linga, Sesame.

Sesame is destructively attacked, especially in rainy times, by a leaf spot, *Cercospora sesami* A. Zimm., which sometimes destroys practically all of the foliage on the plants. On dead and dying stems we have recently found the new *Phoma sesamina* Sacc., and *Gloeosporium macrophomoides* Sacc.

SOLANUM MELONGENA—Egg Plant.

Raimundo has recently found an active parasite on the leaves of this plant in the new *Sarcinella raimundoi* Sacc.

SORGHUM VULGARE—The Sorhgums, Kaffirs, and Milos.

These plants—of great promise here—are often seriously affected by fungi. A leaf disease and a rust often do great damage. Mr. Graff finds the new *Helminthosporium caryopsidum* Sacc. in the seeds.

STIZOLOBIUM DEERINGIANUM—Velvet Bean.

The leaves are often injuriously, affected by a leaf spot, *Cercospora stizolobii* Syd. and by a rust, *Uromyces mucunae* Rabh.

TERMINALIA CATAPPA—Almendra, Talisay.

So far, only one fungus has been recorded from this host, *Ramularia catappae* Racib., affecting the leaves, and formerly known from Java.

THEOBROMA CACAO—Cacao.

Two well known fungi of almost world-wide distribution, *Lasiodiplodia theobromae* (Pat.) Griff. et Maubl. (now referred to *Botryodiplodia*), and *Aspergillus delacroixii* Sacc. et Syd. are abundant here on cacao, and very injurious. Locally, all trees are illy cared for, ragged, unpruned, and covered with dead twigs and mummified fruits. Above 50% of the fruits are lost through fungous diseases. Among several other fungi occurring here on cacao and still undetermined, one afflicts the leaves very severely. Another, *Ophionectaria Theobroma* (Pat.) Duss. is common on the branches.

VIGNA spp.—Cowpeas or Paayap

Among various fungi found here on cowpeas, some of which injure them sorely, only two, a rust, *Uromyces appendiculatus* (Pers.) Lk. and the new *Phoma bakeriana* Sacc., have been determined.

ZEA MAYS—Maiz, Corn.

Out of several fungi found on corn we have the name of but one, *Helminthosporium inconspicuum* C. et E. Dr. Robinson has written a note on this in Philipp. Agr. Rev. IV, 356, 1911, one of the only technical contributions to Philippine Plant Pathology, as such.

Hybridization of Corn

By Nemesio Blanco Mendiola

Thesis presented for graduation from the College of Agriculture No. 25.

I. Objects

These experiments were carried on (1) to find out what natural results are obtained from planting different varieties of corn side by side and (2) to determine whether any of the corn resulting from the hybridization is likely to be superior in yield to parents.

II. Previous Work on Corn Hybridization

Very little, if any, systematic work on corn hybridization has ever been done in the Philippines. At the recent Philippine Exposition, the Indang Farm School, in the Province of Cavite, exhibited three ears of corn which were claimed to be a cross between the native white flint (Moro corn) and an imported white dent variety called the Weevil Proof. This school, according to statements made by the people in charge of the booth, has carried on work on corn hybridization for two years, but has not succeeded in obtaining final results, and has not published any work along this line. In many corn regions, however, broad breeding may be taking place to an indefinite extent between different varieties, for it is not unusual for native corn growers to plant different races near one another. They do not know, of course, that this mixing of blood is taking place; indeed, they are ignorant of the part which the pollen of plants takes in plant reproduction.

The study of maize crosses dates back to earlier than 1724, but the results at this early period, though they represent the work of about 11 students of hybridization, among whom Camerarius, Dudley, Gartner, Vilmorin, and Focke were prominent, were inconclusive. Their researches gave, among other things, several observations on the action of pollen upon the maternal tissue of the seed plant, which phenomenon, Focke denoted as Xenia. (1)

In a later period, from 1789 to 1892, papers on work along the same line were presented by Kellerman, Swingle, McClure, Morrow, and Gardner in the United States, which showed, incidentally, facts that are confirmed in the post-Mendelian work. (1)

According to the same reference above cited, more valuable contributions to the subject appeared from 1899 to 1900, originating with de Vries and Correns, whose work on maize hybrids helped establish Mendel's Law. Correns determined that yellow endosperm and starchiness were dominant to their absence.

Locke carried on an extended series of maize crosses at Peradeniya, Ceylon, from 1902 to 1906. (1) Available literature shows that there has been, up to the present day, an ever increasing study of maize hybridization, especially in the United States, both from scientific and practical standpoints. The practical side of the investigation has resulted in proving that the utilization of first generation hybrids is productive of more general augmentation of the crop than the use of commercial fertilizers, but that experimental work under a wide range of conditions is very necessary because different conditions may give varying amounts of increase from crossing, some of which may not pay. (2)

Probably, it is to Collins, more than to any one else that we owe this knowledge. He has presented a paper which reviews a series of experiments in six different states on the value of first generation hybrids, which scatter over a long period of years, dating as early as 1878. He reported 19 crosses,

aside from those between types from China, Africa, and the American tropics. It appears that all of the 19 crosses, except one, gave larger yields than the average of the parents, the increase ranging as high as 95 per cent. His conclusion was that for corn to give the greatest amount of yield, it must be stimulated by crossing, a work which involves cost that is insignificant, compared with the increased yields obtained. Accompanying this was a statement that "first generation hybrids are a distinct factor in the problem of securing varieties of corn with adaptations that fit them for special conditions," and that "the increased vigor which these hybrids possess should make possible their growth in regions where pure strains fail, and should also provide for some measure of disease resistance." In this connection it may be interesting to mention that this college has carried on in the past some field tests of two or three varieties of corn from the United States (Iowa Ideal) and in every case, the F_1 plants obtained were dwarfed and were little better than the suckers of the native corn. Will crossing with the native strains hasten their acclimatization?

III. Varieties Used

This investigation involved four crosses. The varieties used and their college numbers are given in the following table:

The seeds used were given to the author in a shelled or unshelled condition.

The yellow flint is the most widely cultivated native variety, but is in a second generation only in this College. The white dent is horticulturally known here as the Mestizo corn, obtained from the Luzon Floral Co. The white flint is a variety obtained from the Bureau of Agriculture and is known as the Moro corn. The yellow dent is a small type from Australia.

IV. Methods Used

Each cross was planted in an isolated field, with the idea of lessening the chances of broad breeding, although in this case, this method alone can not be expected to serve this end, for the distance between the two plots farthest apart is only 400 meters, while pollen in one corn field has been known to interfere in pollination in another corn field six miles distant (3). The more reliable method resorted to was the planting of the different crosses at long intervals. Following is the record of dates of planting and flowering.

Cross	*Date of Planting.*	*Flowering.*
I	April 9–11	May 21–25
II	May 8	June 16–28
III	April 22–23	June 8– 9
IV	May 23–24	July 2– 4

TABLE I.

Number of Crosses	*Female Parent and Number.*	*Male Parent and Number.*	*Hybrids*
I	Yellow Flint 184 F2	White Dent 357 F1	(184 F2×357 F1)
II	White Flint 877 F1	Yellow Dent 685 F1	(877 F1×685 F1)
III	White Dent 357 F1	Yellow Flint 184 F2	(357 F1×184 F2)
IV	WhiteDent 357 F1	Yellow Dent 685 F1	(357 F1×685 F1)

The preceding data show that even in the case of crosses I and III, whose dates of flowering were the closest, there had been an interval of at least 13 days, but it is known that corn pollen does not retain its vitality to this age. In a study in pollination between Boone County White and Reid Yellow Dent, it was found that practically no fertilization resulted from pollen 3 days old (4).

The same methods of ground preparation, planting, and cultivation as are ordinarily employed in the College Farm were used.

Cross pollination was accomplished by planting the two races of each cross in alternate rows and detasseling all plants of the race which it was intended to use as the female parent. In fields where studied ears were used, the rows they occupied were carefully labeled and recorded.

There were two methods of detasseling. One is by cutting, which had been used up to July 3. Since this date, tassels had been removed by pulling. The change was made in deference to the statement that "cutting the tassels from the stalks has an injurious effect" (5) and that probably the yield is decreased (6). Moreover, pulling the tassels, facilitated the removal of tassels one or two days at least younger than the youngest that can be removed to advantage by cutting, thus lessening the possibility of the female parent pollinating herself or her neighbors.

In the second crop planting, each field was made to contain both the hybrid and male parents in alternate rows, to give them equal conditions of growth. This was done, as one of the objects of the experiment is to compare the vigor of the old and new races. All parent rows were detasseled to obtain pure F2 hybrids. In one case, several parent rows were left tasseled, at one end of the field, sacrificing the hybrid rows near them, to give some material for comparison in the yield between tasseled and detasseled plants.

V. First Crop Results

From the crossed ears, the desirable ones were selected. The following report consists of tabulated descriptions of nine or ten of the selected hybrid ears from each cross:

TABLE II-A.—HYBRIDS FROM CROSS I.

	EAR			ROW				KERNEL			
Ear Number F 1	Shape	Length mm.	Diameter mm.	Number	Kernels per row	Length mm.	Width mm.	Thickness mm.	Color	Relation of Gluten to Starch.	Diameter of Cob mm.
(184F2–1×357F1-1)	s.t.*	149	49	18	31	8.5	7.5	4.5	light yellow	larger	26
(184F2–1×357F1-1)2	s.t.	184	43	14	28	8.5	8.0	4.0	some white ... some yellow	larger	25
(") —3	s.t.	134	46	16	27	8.5	7	4	light yellow	smaller	29
(") —4	s.t.	140	43	14	32	9	8.5	4.5	light yellow	smaller	26
(") —5	c.	169	44	14	35	7.5	8.0	5.5	light yellow	smaller	31
(") —6	s.t.	198	40	12	39	8.5	3.5	3.5	light yellow	larger	31
(") —2	s.t.	196	44	18	42	9.5	3.5	3.5	light yellow	equal	31
(") —3	s.t.	172	43	14	32	9.5	5.0	5.0	light yellow	equal	26
(") —4	s.t.	188	43	16	32	8.5	3.0	3.0	light yellow	smaller	24
(") —5	s.t.	176	40	12	35	8.5	3.5	3.5	light yellow	smaller	28
Average		171	43	15	34	8.6	4.1	4.1			28

(*) s = slightly. t = tapering. c = cylindrical. v = very.

TABLE II-B.—HYBRIDS FROM CROSS II.

	EAR			ROW			KERNEL				
Ear Number F 1	Shape	Length mm.	Diameter mm.	Number	Kernels per row	Length mm.	Width mm.	Thickness mm.	Color	Relation of Gluten to Starch	Diameter of Cob mm.
(877F1×685F1)–1	s.t.	192	36	14	14	8	8	7	most white, some yellow	larger	28
(877F1×685F1)–2)	s.t.	115	37	10	19	7	9	6.5	light yellow	larger	25
(") —3	v.t.	142	41	14	22	7	10	5	light yellow, most white	larger	28
(") —4	s.t.	136	40	10	15	6.5	7	8	some yellow, some white	larger	27
(") —5	s.t.	150	37	10	10	8	9.5	6.5	some yellow, some yellow	larger	28
(") —6	s.t.	129	42	14	23	7	9	6.5	most white, some white	larger	29
(") —7	s.t.	186	38	10	20	8	9.5	5	some yellow, most white	larger	26
(") —8	s.t.	196	38	12	16	7	10	7.5	few yellow	larger	28
(") —9	s.t.	196	39	14	12	7	10.5	7	white	larger	35
(") —10	s.t.	146	42	16	17	7	9	6	light yellow	larger	32
Average		159	39	12	16	7.2	9.2	6.5			29

TABLE II-C.—HYBRIDS FROM CROSS III.
(357F1×184F2—5) F1

	EAR				ROW	KERNEL							COB	
Ear Number	Shape	Weight gm.	Length mm.	Diameter mm.	Number	Kernels per row	Weight gm.	Length mm.	Width mm.	Thickness mm.	Relation of Gluten to Starch	Color	Number Dent	Weight gm.	Diameter mm.
1	v.t.	245.2	192	52	14	37	.39	11	12	3	smaller, above	white, yellow, below	all dent	43.2	31
2	s.t.	87.4	145	45	14	32	.18	9.5	8.5	4	equal	yellow		16.8	32
3	s.t.	125.1	187	40	10	36	.29	12	9	4	equal			20.7	22
4	s.t.	113.7	170	39	10	30	.30	10	10	4	smaller			23.7	20
5	t.	154.5	135	47	16	35	.24	11.5	6	4.5	smaller			20.1	26
6	v.t.	116	144	46	12	34	.23	12	11	3	smaller			22.2	28
7	s.t.	204.7	160	51	18	34	.28	12.5	7.5	4	larger			33.4	29
8	c.	126.2	153	45	12	38	.29	12	12	4	smaller			31	29
9	s.t.	172.8	163	43	12	31	.39	13	8	4	smaller			27.8	24
Average		144.6	161	45	13	34	.28	11.5	9.3	3.8				26	26

TABLE II-D.—HYBRIDS FROM CROSS IV.
(357F1×685F1) F1.

1	v.t.	165	154	45	14	32	.24	12	6.5	2.5	all smaller	white, yellow	all dent	20	20
2	c.	153	138	45	14	32	.31	11	9	2.5	except No. 7	yellow	below	23	30
3	c.	167	136	47	14	34	.25	12	7	2.5				21	27
4	c.	173	140	53	14	34	.26	11	8	2	larger			25	30
5	c.	175	138	52	16	31	.30	13	7.5	3				22	29
6	s.t.	159	137	42	12	29	.35	12	9	2				19	31
7	s.t.	160	150	46	14	32	.24	12.5	7.5	4				24	26
11	s.t.	155	143	44	14	31	.28	12	9	2				25	27
9	s.t.	150	138	45	14	29	.28	11	9	2.5				25	27
10	c.	135	129	48	14	27	.30	12	9	2				20	26
Average		159.2	140	47	14	31	.28	11.7	8.5	2.6				22.4	27

A careful examination of the hybrids resulting in the four crosses, showed that they do not deviate from their female parents, as far as their physical characters are concerned, except in the color of the endosperm. This result agrees with Shull's conclusion that "The F1 hybrids are no more variable than the pure strains which enter into them. . . ." (7). As regards crosses II-IV, where the male parents have yellow kernels and the female, white, in the crossed grains the two colors were blended except at the uppermost portion which appeared white. This is in accord with East and Hays' result, in a study of a cross between strains with white and yellow endosperm, where they observed that yellow appeared as Xenia in the F1 kernels (8). In cross I, where the female had yellow endosperm and the male, white, the crossed grains showed a marked change in color from yellow to light yellow. In a few ears, however, there was no blending of color, as in ear 2, Table II-A. The grains were either pure white or pure yellow. This is also true with some of the hybrids in all other crosses.

Refering to Table II-B, it will be noticed that the average number of kernels per row of the hybrid ears, though they were the best and most filled ears of the cross, is only 16, a number which is very low. In fact, a more general average falls very much lower than this, for a count of the kernels of 111 ears, including those reported in the above mentioned table, gave an average of only 40 kernels per ear, or an average of 4 kernels per row. The cause of this can be no other than imperfect pollination resulting from the great difference between the flowering ages of the two races crossed. The Yellow Dent which was the tasseled variety, flowered on June 16, but the White Flint did not produce most of the silk until June 28, 12 days later. It may be recommended, therefore, to future breeders who may happen to study the same cross, to plant the White Flint 12 days ahead of the Yellow Dent.

VI. Second Crop Results

(a) *Progeny from Cross III*

Crossed seeds from all four crosses were planted for the second crop, but those from crosses I and II, during the germination, were destroyed by crows in their attempt to pick out peanut seeds left in the field by a previous crop. No sufficient amount of seed was left to constitute a reasonable re-planting. Second crop results can be reported only from crosses III and IV. The following report consists, in brief, of the average of the physical characters of 50 F2 hybrid ears and 50 male parent ears, all of which represent the best ears obtainable from a reasonable sampling of the whole crop produced. These ears were selected from ten rows of the different parts of the field, ten ears being taken from each row of each variety; whatever row of the hybrid ears was made a source, the parent row next to it was also taken.

To obtain similar data for the original female parent, 50 best ears were selected from different parts of a field of white dent corn which were harvested on January 19 and 20. This was a crop grown in the same season. It should also be noted that the ground in which this last crop was grown had never been used for corn, but was preceded with Vetiver grass (Andropogon zizanioides) for about three years. These 50 ears were studied and treated as the 100 ears were, and the results were averaged also.

In the final comparison between the hybrids on the one side and the male and female parents on the other, the following tabulated data will be required:

TABLE III-A.

Variety	*Average No. of plants per Hectare*	*Average No. of fertile ears per plant*	*Average No. of sterile ears per plant*	*Average height of ear on stalk*
Male parent—184F2	20000	1	.9	7 dm.
Female parent 357F1	26600	1.99	.7	8 dm.
Hybrids (357F1×184F2)	20000	1.4	1	6 dm.
Direct-Cross	20000	.9		

The average number of plants per hectare for each variety appearing in the table above was obtained from computation in which the number of plants per hill, the distance between the hills in the row, and the distance between rows entered into consideration. The average number of fertile and sterile ears per plant was obtained from actual counts of the fertile and sterile ears of 400 plants of each variety, except in the case of direct-cross ears (Xenia products) where only 100 plants were concerned. The height on the stalk of all fertile ears in each 400 plants was measured and from the data obtained, was calculated the average height of ear in the plant.

Averages

In order that the hybrid can be easily compared in general, with its parents, including the direct-cross generation, the average of characters for each of them mentioned already is placed in the next Table. In this table the numbers appearing opposite "Hybrid" represent averages of 50 hybrid ears (White Dent × Yellow Flint); those opposite "Male Parent," of male parent ears Yellow Flint; those opposite "Female Parent," of White Dent; while those opposite "Xenia Ears" were obtained from Table II-C.

To furnish data for comparison of the upper extremes in characters of the same members of the family just mentioned above, the characters of the best representative ear from each strain are also placed at the latter half of Table IV-A, and headed "Best Ear." Numbers, therefore, coming under "Best Ear" differ from those above them in that the former represent characters of single ears, while the latter are averages of a number of ears.

TABLE IV-A.—AVERAGES

	EAR		ROW			KERNEL				COLOR			COB	YIELD	
Varieties	Weight gm.	Length mm.	Diameter mm.	Number	Kernels per row	Weight gm.	Length mm.	Width mm.	Thickness mm.	Yellow	Mixed	White	Weight gm.	Diameter mm.	Grain Per Ha. Kg.
Hybrid	245	194	47.6	13.8	39.7	.35	10.7	9.5	4.2	148	305	95	44.3	26.7	5620
Male Parent	206.1	193.1	43.9	14.2	38.8	.29	9.2	8.6	4.5				34.5	27.9	3432
Female Parent	217.4	171.4	42.4	14.2	38.8	.25	11.6	9.4	4				34.5	28.5	4816
Xenia Ears	144.6	161	45	13	34	.28	11.5	9.3	3.8				26	26	2135
Best Ear															
Hybrid	316.4	220	51	16	38	.39	11	10	4				78	29	
Male Parent	274	184	49	16	40	.33	11	9	4.5				51	33	
Female Parent	271	167	58	18	33	.38	13	9	4				38	33	
Xenia	245.2	192	52	14	37	.39	11	12	3				43.2	31	

A new column was added for yield in grain per hectare of each variety. This quantity, as to be found in the table, was computed by multiplying the average weight of grain per ear of each strain by the average number of fertile ears per plant, found in Table III-A, and multiplying the product in turn by the average number of plants per hectare. The average weight of grain per ear was obtained by substracting the average weight of the cob from the average weight of the ear.

VII a. Conclusions from First Generation Hybrids of Cross III. (Between White Dent, Female, and Yellow Flint, Male)

When the averages of each strain are compared, the following conclusions can be drawn:

1. That the first generation hybrid is more productive than either of the original parents. Compared with the male parent, its yield in grain per hectare is higher by 63 per cent. It will be noticed also that the hybrid has gained in the length and diameter of the ear, the number of kernels per row, and in the weight, length, and width of the kernel. The diameter of the cob, as can be expected from the increase in length of the grain, has been diminished. The increase in the diameter of the ear appears to have been caused not by an increase in the number of rows, for this quantity tends to decrease, but by an increase in the width of the grain. The increase in the total weight of the ear was accompanied by an increase also in the weight of the cob, in a quantity, however, not sufficiently great to balance the increase in the total weight of grain obtained.

2. Compared with the female parent, the increase in yield in grain per hectare is 16 per cent. Again the hybrid has gained in the length and diameter of the ear, in the number of kernels per row, and in the weight of the cob. There is a slight tendency for the number of rows to diminish. Practically, the hybrid has neither gained nor lost in the weight and width of the grain. Considering the length of the kernel and diameter of the cob, there seems to be a tendency for the hybrid to go back to the flint type in these respects.

3. In a count of the kernels of the 50 hybrid ears studied, representing a total of 27,396 grains, there came out an average ratio in each ear of 148 pure yellow kernels, to 45 pure white to 305 intermediates. In this connection it should be remarked that it was quite difficult to decide when a kernel is pure white or pure yellow.

4. As will be stated below, the yellow type seems to dominate. This is further confirmed by the fact that there are per ear more pure yellow kernels than pure white. On the other hand, there are more dent kernels than flint. In this respect the dent character seems to dominate.

5. Comparing the average of the hybrids with that of the direct effect of pollen (Xenia), it appears that the immediate effect of crossing is not as important as the results from crossed seed. This result is in accord with that obtained by the Agricultural Experiment Station of Maryland (9); but the comparison here given is not intended to be emphasized.

A general statement covering the type of the hybrid must take the place of averages, concerning the items:—shapes of ears and kernels, and relation of gluten to starch. A careful examination of the greater part of the harvested hybrid crop showed that, besides the length and color of the kernels already mentioned above, the resulting strain shows much of the flint characters in the shape of the ear. Most of them

(*Continued on page 174*)

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ADDRESS ALL COMMUNICATIONS TO THE BUSINESS MANAGER, LOS BAÑOS, LAGUNA

Plant Breeding in the Philippines

A month or two ago, Mr. Jacobson of the Bureau of Agriculture published an account of the first effective work on rice selection done in the Philippines. In this issue of our journal we publish the first real work on corn breeding in the Philippines. With these two pieces of scientifically controlled work, Plant Breeding registers its birth in the Philippines. Just what it means to the Islands is undoubtedly unknown to most people, specially to those who do not care to improve their grains or are merely content with the yield of eight and fifteen cavanes of corn or rice respectively. But to those who have the ideal of putting their harvests on a level with those of other countries, the event is of great significance. It means a new era of plant industry in the Philippines; it means a signal triumph of modern agriculture over primitive farming; it points to prosperity and a more stable future.

What we desire here in the Philippines is not only a sufficient production of all we need ourselves, but enough to export and to leave with us a generous ba ance of trade. One sure outcome of Plant Breeding in the Islands will be the rehabilitation of our neglected plant industries and the improvement and increased production of our crops. To the ordinary farmers these claims may not be clearly understood and may be passed unnoticed, but to those who are perfectly acquainted with the results of the work of Le Couteur, Shirreff, Hallet, Hays, Nilsson, Burbank and many others, they appeal very strongly and would be pronounced wholly and immediately possible and practical. We welcome the day of its coming and more we greet it with the most unusual interest as we hope eventually to send out rice instead of paying annually ten million dollars to Indo-China and British Indies for what we consume. We might say the same of coffee, cacao, onions, potatoes and many other things.

A Needed Measure

During this constructive period when the slogan is material development, agricultural legislation should proceed without interruption. From time to time we hear of bills and measures passed by the Legislature purporting

to have the aim of protecting the interests of the farmers. We have seen the gradual development of the locust and rinderpest campaigns, the banking facilities, the cadastral survey, the government loan, and the cooperative societies. The list of such beneficial legislation might be much longer than what we have given, and on seeing it the people might think we had already accomplished everything necessary toward the promotion of our agricultural interests. However, other highly important measures remain to be considered. For instance, we yet lack one very important measure, the protection of our local plants from pest and diseases from without. Our animals are protected from diseases and pests from abroad by the examination of the condition of the imported cattle before they enter the ports, and by withholding entrance into the country if they are found affected with communicable diseases. But in the case of our crops there is no such measure Is it because we ignore the susceptibility of plants to diseases and pests or is it because there is no serious outbreak just at this moment to force it upon our attention? As a matter of fact, plants are no more free from pests and diseases than are animals. In fact millions of dollars are lost to the farmers of the world by the ravage of fungi and insects, and Philippine farmers have suffered heavily in this connection. We wish to emphasize the fact that we can not afford to wait to quench the fire after one-half of the house has already been burned. The point is this, that it is more difficult to control the outbreak of any disease or pest than to entirely prevent it. We have before us now the example of Massachussets and the Federal Government, which are spending millions of dollars in attempting to check the devastations of the gypsy moth which was introduced into the country by an accidental liberation of a very few specimens.

The assertion that a certain insect or fungus does no damage at home can not assure us of freedom from a serious outbreak. It is harmless in one place because it is checked by its natural enemies but brought into a spot where nothing controls it, it may multiply very rapidly and cause extensive damage.

Every day boats from foreign ports dock at our harbors with loads of fruits and plants consigned to local firms. In more than one instance we have found specimens of serious insect pests on oranges and other fruits and plants, and not less frequently, the spores and mycelia of assorted parasitic fungi are brought in with sugar cane and other plants from foreign countries. Without any regulation to prevent the introduction of insects and fungi into the country we are simply exposing all our local crops to infection, and as a consequence we will surely pay very dearly for our negligence and lack of foresight. Our experience with the rust that wiped out our coffee industry is too sad to be repeated, and the danger of repetition is too great to tolerate any delay. San Francisco and other ports of the Union possesses adequate quarantine service, and a thorough examination of all fruits and plants landed is carefully conducted with result that many serious pests and diseases are constantly being intercepted and the infected materials either destroyed or returned. The farmers of California and the other States are most emphatic in demanding this very effective protective. They have, just as we do, local troubles enough, without importing more. But the barn should be locked before the horse is stolen.

J. J. M.

are tapering as are the male parent. This confirms the result of an experiment in the United States where it was shown that the flint characters were usually very marked in the second year ears, whether the dent parent be the male or female (10). The relation of gluten to starch, as compared with both parents, has not been modified. Besides this general type, 5 distinct types, each represented by 2 to 6 ears, were separated. One is almost the flint form, except for some dent kernels, and the color, but the point to be noted is that it possesses white flint kernels, pointing to the existence of the native white flint blood (Moro corn blood) in the original male parent. Two of these types are distinct departures from the two parents and suggest a possible, but problematical, improvement. Both have extraordinarily deep and broad kernels. One differs from the resulting general hybrid type in having most of the kernels yellow, but the kernels are a great deal deeper. The last type is starchy, possessing a short ear and deep but small kernels.

Looking over the characters of the best representative ear of each strain, it will be noticed that the hybrid has gone beyond the parental maximum in weight and length of the ear and in the weight of cob; and below the parental minimum in the diameter of the cob.

One advantage of the hybrid produced over either of the two parents, is that the average height of ear on the stalk is less, and hence it is less susceptible to the effect of storms. It will be noticed also from Table III-A that this strain has a greater average of sterile ears per plant.

TABLE III-B.

Variety.	*Average No. of plants per Hectare*	*Average No. of fertile ears per plant.*	*Average No. of sterile ears per plant.*	*Average height of ear on stalk.*
Hybrid White Dent × Yellow Dent	20000	1.08	.6	6 dm.
Male Parent, Yellow Dent.	20000	.86	1.3	4 dm.
Female Parent, White Dent.	26600	.99	.7	8 dm.
Xenia Ears	20000	.9	——	——

TABLE IV-B.—AVERAGES.

	EAR			ROW		KERNEL				COLOR			COB	YIELD IN GRAIN	
Varieties	Weight gm.	Length mm.	Diameter mm.	Number	Kernels per row	Weight gm.	Length mm.	Width mm.	Thickness mm.	Yellow	Mixed	White	Weight gm.	Diameter mm.	per Hectare Kg.
Hybrid	288.2	206.7	49.7	14.2	46.4	.34	14.2	9	3.6	106	418	135	49.4	24.7	5158
Male Parent	199.6	177.6	44.3	13.2	43.8	.29	14.7	8.2	3.5				28.1	20.1	2950
Female Parent	217.4	171.4	42.4	14.2	38.8	.35	11.6	9.4	4				34.5	28.5	4816
Xenia Ears	159.2	140	47	14	31	.28	11.7	8.5	2.6				22.4	27	2462
Best Ear															
Hybrid	484	270	55	14	63	.49	14.5	9.5	4				83	27	
Male Parent	310	215	51	16	54	.28	17	8	3.5				48	23	
Female Parent	271	167	58	18	33	.38	13	9	4				38	33	
Xenia	165	154	45	14	32	.24	12	6.5	2.5				20	20	

VI. Second Crop Results

(*b*). *Progeny from Cross IV*

As was done with the report on progeny of Cross III, the next report consists of tables arranged as are the preceding ones. Table III-B on the preceding page, contains data required in the computation of yield in grain per hectare of each variety. In this case, only 250 plants could be taken from each of the hybrid strains and the male parent (Yellow Dent) to furnish figures for the average number of fertile and sterile ears per plant and for the average height of ear on the stalk. As the female parent of this hybrid is also the White Dent, all data appearing in this report for this variety are but the duplicate of those which have already been given in part VI (a) of the report.

Table IV-B contains the averages of the characters of 50 selected hybrid ears (White Dent × Yellow Dent), 50 male parent ears (Yellow Dent), and 50 female parent ears, (White Dent).

VII-b. Conclusions from Results in Hybrids (White Dent × Yellow Dent)

1. Compared with the male parent, Yellow Dent, the gain in yield in grain is 75 per cent. As regards the characters of the ear and its parts, it will be noticed that compared with the male parent, the hybrid has gained in the length and diameter of the ear; in the number of rows and in the number of kernels per row; in the weight, width, and thickness of the kernel; and in the weight and diameter of the cob. In other words, the hybrid has gained in almost all of the important characters, except in the length of the grain, all of which, except the weight and diameter of the cob, ought to be counted to its advantage.

2. Compared with the average of the White Dent, which was the female parent, the increase in yield is 7 per cent. There are gains in the weight, length, and diameter of the ear; in the number of kernels per row; in the length of the grain; and in the weight of the cob. The hybrid has not departed from this parent in either direction, in the number of rows of kernels. Loss is shown in weight, width, and thickness of the grain, and in the diameter of the cob. In these respects, therefore, the hybrid seems to depart from the type of the female and approach the male. One character that can not be shown in the table is the color of the cob. The cobs of the male parent ears are all purple, those of the female, all white, but 48 of the 50 cobs of the hybrid ears studied were purple. The other two were white. Of the 48 only two showed intermediacy. The male parent, therefore, seems to be prepotent in this special character which, with the white, does not seem to conform with any Mendelian ratio.

From all that has so far been said, it will be noticed that the hybrid type has gained over both parents in the weight, length, and diameter of the ear; in the number of kernels per row; and in the weight of the cob.

3. In the count of the kernels of the 50 hybrid ears, representing a total of 32,992 grains, there was as an average per ear 106 pure yellow, 418 mixed, and 135 pure white. This and the ratio existing in the hybrid from cross III (White Dent × Yellow Flint) do not differ greatly in the ratio found in the hybrid resulting in a cross between Reid Yellow Dent (male) and Boone County White (female), which was 486 pure white to 1,306 mixed to 208 pure yellow (11).

4. Contrary to what was shown in the other hybrid, the white color of the kernels here seems to be dominant

over the yellow, for per ear there were more pure white kernels than pure yellow.

5. Compared with the direct-cross ears, the result in this cross confirms the conclusion that the result from crossed seed is more important than the direct effect of crossing.

As regards the general type of the hybrid, it can be stated, when the ears are observed as whole, that the shape of the ear appeared to have been inherited from the male parent, except in the diameter which is distinctly female. In general, also, the shape of the kernels approaches that of the male in being wedge shaped, instead of being round. No modification resulted in the relation of gluten to starch in the kernel.

Aside from the general type, four distinct types were separated all of which indicate possible improvements. Type (a) is characterized by being the longest ear in the group, in fact, many who have seen the ear claimed it to be "the longest ear of corn they have ever seen in the islands." The improvement pointed in this type is the size of the ear, and the fact that two good characters, one from each parent, namely, the width of the kernel from the female and thickness of the same from the male, are combined in this form. Type (b) is characterized by having rather flat but deep kernels in the form of a narrow wedge, and the crown, rough and chaffy. One good character of type (c) is shown in the ears being cylindrical. The kernels show advantages over that of the female, which in many respects is similar to that of type b, except in width. The last type, type d, is slightly tapering as the male parent. The length and width of the kernel approach those of type (a), but the crown is round and smooth.

Considering the maximum of each strain, as represented by the best ear, the hybrid shows a higher apex in the weight and length of the ear; in the number of kernels per row, as should follow from the length of the ear; in the weight and width of the kernel; and in the weight of the cob, all of which may be counted to its advantage except the last.

Regarding characters of the whole plant, the hybrid has the advantages of having the largest number (average) of fertile ears per plant, and the least number of sterile ears. The height of ear on the stalk was intermediate between those of the male and female parent plants.

VIII. Effect of Detasseling

So far as the conclusions from the two produced hybrids go, indications are such as to point to their superiority in vigor over their parents, but before any final conclusions should be drawn as regards their merit or demerit, there is one point in the experiment which affects the conclusions already shown and should not be overlooked. It will be recalled from the discussion of the methods used in cross pollination that the parent rows were detasseled. The question is whether it affects the yield of the crop advantageously or disadvantageously, and if the latter, whether the effect is so much as to balance or overcome entirely the gain to be obtained in the hybrids.

To determine this, parent rows alternating with the first generation hybrids were detasseled at one end of the field, and other rows were left detasseled at the other end. When the crop was harvested, the yield from 5 rows of each set was compared, which gave a gain of 18 per cent in grain in favor of the detasseled. It should be remembered also that the average characters

of the 50 Yellow Flint male parent ears with which the first set of hybrids was compared were obtained from ears produced from detasseled rows. If we are to compare this hybrid's yield per hectare with that of the male parent, tasseled, which is the most proper comparison, the 63 per cent gain already counted in its favor will be raised to 93. It therefore follows that the experiment resulted in proving that not only is a new strain produced superior to either of the parents, but also the method used is such as to give a gain along another line, which should more than amply pay the labor it took to do the detasseling. This is not the only experiment to give the same conclusion, for several experiments in the United States covering a long period of time and scattering over a great area of the corn regions in that country showed in many cases that detasseling alternate rows gave increased yields which may ascend to 50 per cent (12).

CONCLUSIONS

1. That it will pay to cross corn.

2. That from planting different strains of maize near one another can be expected the production of new strains which are superior in yield and in other physical characters in the F generation to either parent or to Xenia products.

3. Crossing widely separated varieties or strains within the same general type is beneficial in that not only is a more vigorous race produced, but there is a chance also for more combinations of good qualities.

4. Hybridization of corn tends to create new types of the species which may make possible distinct improvements. Only subsequent cultures will test this.

5. The labor of detasseling alternate rows is small and gives an increase in yield.

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The author desires to express his thanks to Prof. Charles F. Baker for his valuable suggestions and criticisms throughout the course of the work.

News and Comments

A New College Building Inaugurated

In these days of stringent economy on the part of our government it is a matter of unusual pleasure to us to announce the inauguration on Nov. 7 of our new Laboratory Building, which is to house the departments of Physics, Rural Engineering, and Botany. In the words of our Dean, "the new construction is the strongest of its kind and the cheapest of its quality."

The occasion has been graced by the presence of the Governor General, Speaker Osmeña, President Bartlett, members of the Board of Regents, and of other important men in public life. The Dean and Mr. Catalino Aurelio spoke in behalf of the College and Student Body respectively. The former dwelt on the remarkable development of this institution and its present needs. Mr. Aurelio's speech has already been published in the Dec. 5 issue of the FREE PRESS. The Chief Executive and the Speaker were introduced by the President of the University and spoke for the government. We are glad to be able to publish in this issue the speech of the Governor General.

"I thank you for the opportunity to be present on this splendid occasion. I am glad to have the privilege of listening to the addresses of Dean Copeland on behalf of the faculty of the college, and of Mr. Aurelio on behalf of the student body. To be sure, when listening to Dean Copeland's remarks, I began to wonder whether I really was in Los Banos or back in the session of the Commission in appropriations committee. I do not know that we can provide you with all of the money that he asks for, but if any man can buy a mess hall, a laboratory, a printing press, and equipment of microscopes and other things for ₱160,000, he ought to have it. I am now in some doubt as to why I am invited to come up here.

"The Dean says that he is going to label us as rare birds. That may explain why we are able to be present in Los Baños during a busy session of the legislature, because we have the authority of the Irishman who remarked that no man can be in two places at once, barring he's a bird.

"I wish that I could speak to you about agriculture as a science, but I was born in a city, brought up in a city, and have lived in cities all my life. The practical side of agriculture has always seemed to me like a beautiful dream. It has been for me the *rus in urbe* of the Latin poem. What I can speak to you about is the interest that this government takes in the agricultural development of the islands, and particularly in the development of this agricultural school. My good friend, President Bartlett, has done a great deal for the scholarship and for the refinement of education in the Philippine Islands, and he has also done a great deal in a material way to forward the cause of education. And I assure you that it was no small achievement on the part of President Bartlett that last winter, in the hour of stringent economy, he was able to secure from the Legislature ₱33,000 for this building. I must tell you that I believe you have President Bartlett personally to thank for the fact that the need of money for this building was brought home to the Legislature at that time of economy. We are anxious that agriculture shall go forward uninterrupted and in complete progress throughout the Philippines, and we are anxious that these young men who are gathered here together today shall, upon their graduation, go throughout the Philippines preaching the gospel of efficiency and more efficiency. We are anxious to have your people know, through you, that in many respects the wealth of the Philippines yet remains undeveloped, that their wealth is agriculture, and that until modern science lays its hands upon the agriculture of the Islands, they cannot blossom like the rose.

"You, young men, must teach the people how much they can advance the production of your staple crops. You must teach them to grow more and better sugar. You must teach them more care in the production of hemp. You must teach them the necessity of individual and cooperative irrigation in the rice fields, and you must teach them how to produce better copra. The Philippines are the natural home

of the coconut, and yet today, on the markets of the world, the Philippine copra is the lowest priced of all. The people cut the nuts before they are ripe, and they take but little care in the drying of copra. It is to you that your people must look for more accurate knowledge and for the inspiration towards greater economy in their production. I think it is a magnificent thing that we have in this college this clean, intelligent and progressive type of young men that I see before me; because this is to me an evidence that you appreciate what I believe, that of all the occupations in the world, none is nobler than that of agriculture.

"As I stated to you last year, the happiest of human societies is founded upon the basis of agriculture, and the happiest man in the world is the independent farmer who owns his own land and produces enough food to supply himself and his family, and sufficient income to provide his children with education. You have, in your soil, one of the richest countries in the known world. You have a large, intelligent and progressive population. Gentlemen of the college, the cause is in your hands. It is before you that the opportunity lies to open the door to prosperity such as your ancestors never dreamed of!"

Student Body Honors Member of Faculty.

In the event of the separation of Assistant Professor Samuel B. Durham from the University of the Philippines in which he has been the chief of the Department of Animal Husbandry in this College since the establishment of this institution, the student body expressed its sentiment in the following resolution:

WHEREAS it has been announced that Assistant Professor Samuel Bert Durham, Chief of the Department of Animal Husbandry, and one of the most experienced animal husbandmen in the Philippine Islands, is soon to sever his connection with the College of Agriculture;

WHEREAS we can hardly repay him for his invaluable services in training future Filipino farmers during his connection with this institution for over five years, and equipping them with such knowledge of their farm animals as is so essential to the well-being of our agricultural enterprises, and, hence, to our prosperity; be it therefore

RESOLVED that in the departure of Assistant Professor Samuel Bert Durham the College of Agriculture will suffer a great loss and the students will miss a friend and benefactor; and be it further

RESOLVED that the students of the College of Agriculture receive the news of Assistant Professor Durham's parting with heartfelt regret; and be it further

RESOLVED that a copy of this resolution be sent to Assistant Professor Samuel Bert Durham before he leaves, that a copy be kept in the record of the Student Body of the College of Agriculture, that copies be sent to the office of the Dean of the College of Agriculture and to that of the Registrar of the University of the Philippines for file, and that a copy be furnished to the Editor-in-Chief of the PHILIPPINE AGRICULTURIST AND FORESTER for publication.

Current Literature

The Yearbook of the Department of Agriculture, etc., of the Dutch East Indies for 1913, has appeared with the usual review of the enormous amount of agricultural work carried on under the East Indian Government. Of particular interest to this college, in view of the large amount of work being done here with root crops, are the attempts made at Buitenzorg to improve Cassava and Sweet potatoes by developing strains from seedlings. Of Cassava, sixty-three varieties have been tested during the last three years at Buitenzorg, of which the twelve best are listed by name. Of these, eight are varieties abtained from Brazil, three are native Javanese, and one is a seedling. The use of seed with sweet potatoes promises results of surprising value. Figures were given on yield by parent and seedling offspring of two strains as follows:

	Piculs of tubers per bouw
Kangkoeng item (parent)	66
Kangkoeng item (seed variety No. 4)	175
Boled (parent)	131
Boled (seed variety No 15)	245
Boled (seed variety No. 23)	186
Boled (seed variety No. 28)	225

ELECTION RETURNS

The recent election has brought changes in the administrative personal of the Student Body. The following were elected:

President - - - - - - - - JOSE Q. DACANAY
Vice-President - - - - - - - VICENTE ALDAVA
Secretary - - - - - - - - MARIANO C. LOPEZ
Treasurer - - - - - - - - RAFAEL B. ESPINO
Athletic Representative - - HILARION S. SILAYAN

STAFF OF THE JOURNAL

Editor-in-chief - - - - NEMESIO B. MENDIOLA
Assistant-Editors - - - - LEOPOLDO MENDOZA, LEOPOLDO LICHAUCO
Business Manager - - DOMINGO B. PAGUIRIGAN
Assistant Managers - BLAS C. VELEZ, FELIX SARAO